

The Elusive Sea Bug *Hermatobates*¹

(Heteroptera)

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Although the genus *Hermatobates* was first established in 1892, the nine known species have hitherto been represented by only 14 type specimens and the females of only two species have been described (Table 1). In no case has a species been described from more than three specimens. Several sea-going entomologists have sought these elusive sea-bugs, but few have been successful and it is quite apparent that these insects are rare. Although clearly distinct from other known marine hemipterans as a generic entity, *Hermatobates* was included in the family Gerridae by all the earlier authors, although, its affinities to the other genera are unclear. Matsuda (1960), in his monograph of the World Gerridae, excluded *Hermatobates* from the family on the basis of several important structural differences, notably the completely fused meso- and meta-thorax in the male, the highly modified meso-notum with lateral lobes in the female, the three-segmented tarsus of all the legs, the granulated appearance of the eyes, and the presence of a scent gland opening on the dorsal surface.

The insects are certainly very different from the Gerridae and should be treated as a separate family (Andersen and Polhemus, 1976). However, until we can establish the systematic importance of various characteristics it is difficult to decide the phylogenetic relationships of *Hermatobates* to other aquatic Heteroptera.

Systematics and Review of Literature

Carpenter (1892), who discovered these insects, described the genus *Hermatobates* on the basis of a single male specimen, which he named *H. haddoni*, collected from coral reefs off the Australian coast. Since his specimen was very different from all other known gerrids, he suggested assigning it to a special subfamily (Hydrometridae in his paper). A second species, *H. djiboutensis*, was added by Coutière and Martin (1901a), who in the same year (1901b) described a third, *Hermatobatodes marcheii*, and created a new subfamily, Hermatobatinae, to include these two genera (1901c). Bergroth (1906) found that these two genera were distinguished merely by sexual differences, since the two earlier species were only known from the males, and therefore synonymised *Hermatobatodes* with *Hermatobates*. *H. marcheii* was synonymised with *H. haddoni* (Esaki, 1947) but the earlier name was later resurrected by China (1957), who des-

¹This paper was originally accepted for publication in *Pacific Insects* (see Cheng, 1976); it has been withdrawn owing to printer's problems at that journal.

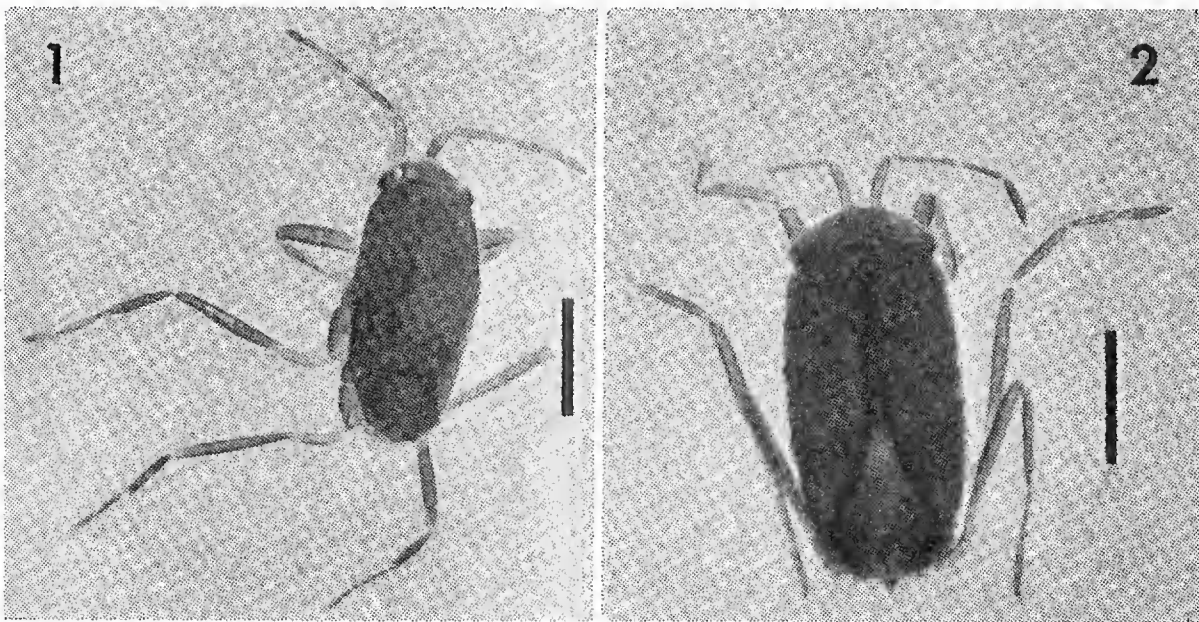


Fig. 1. *Hermatobates hawaiiensis* male, dorsal view. Fig. 2. *Hermatobates hawaiiensis* female, dorsal view (scale bar = 1 mm).

cribed three more species, *H. hawaiiensis*, *H. walkeri*, and *H. weddi* (1956, 1957), and constructed a key to the six known species (1956). Two more species, *H. breddini* and *H. tiarae*, were added by Herring (1965) and yet another was described by Cheng (1966, 1969), bringing the total number of known species in the genus to nine. Since most of the species were described from one or two type specimens (see Table 1), and substantial intraspecific variations were found among specimens examined in this study, it is impossible to construct a meaningful key to the species at present.

Distribution

The recorded localities of all nine *Hermatobates* species are shown on Map 1. They are widely distributed, with representatives collected from the Indian, Pacific, and the Atlantic Oceans. However, six of the nine described species are known from only the type localities. Of the remaining three, *H. djiboutensis* has been collected from Djibouti and the Maldive Islands (Phillips, 1959), *H. hawaiiensis* appears to be confined to the Hawaiian Islands, whereas *H. haddoni* has been reported from Troughton Island (14° 45'S, 125° 10'E, Arafura Sea; Walker, 1893; Carpenter, 1901), Monte Bello Island (China, 1957), the Ryukyu Islands (Esaki, 1947), and Tahuata in the Marquesas Islands (China & Usinger, 1950) in addition to its type locality (Mabuiag Island). The Tahuata record was based on only one nymph, of which the specific identity has been questioned by Herring (1965), as has that of the specimens from New Caledonia and the Ryukyu Islands. In an earlier paper, Esaki (1935) himself expressed uncertainty as to the identity of the specimens, but he later decided that they belonged to *H. haddoni* (1947). Since at that time no other Pacific species had

been described, and since all other known *Hermatobates* species are rather restricted in their distribution, we cannot verify the presence of this species in the Ryukyus and New Caledonia until Esaki's specimens can be reexamined or until other collections from these localities become available. The other records of this species, from the Marquesas, Palmyra and Christmas Islands (Herring, 1965; China, 1956), were all nymphs, hence their specific identity could not be ascertained either.

More recently some specimens of *Hermatobates* have been collected from Low Isles, Australia, but they have not been identified to species (Marks, 1971). During several recent collecting expeditions specimens of *Hermatobates* were collected from localities where it has not been previously reported: Enewetak Atoll, Fiji, Tonga, New Caledonia, Heron Island and Magnetic Island off the coast of Queensland, Australia, and Pulau Salu off Singapore. In Enewetak, Fiji and Tonga adults attracted to lamps at night were netted as they skated towards the light. They were caught at or shortly before low tide. Collections at Enewetak were made at Japtan and Medren Islands from dinghies anchored near wooden piers several hundred meters offshore, in the vicinity of live corals. In Fiji, the insects were caught near the Marine Science Institute, University of South Pacific, Suva, beside a pier encrusted with barnacles and surrounded by coral rubble. In the main harbour of Nuku Alofa, Tonga, some specimens were caught when attracted to a light hung over a stone pier 3 meters wide, several hundred meters long, about 100 meters from shore and level with the reef flat; others were caught by random sweeps under an overhanging shelf near the light on the leeward side of the pier; none were caught from the windward side. These collections probably represent yet other new species which will be described at a later date.

General Structure

All known specimens of *Hermatobates*, like those of *Halobates*, are wingless. The bodies of adults are dark brown or black, and measure 2.5 to 4 mm in length and about 1 to 2 mm in width. The nymphs are brown, but otherwise are similar to the adults in general structure. The body and all the legs are covered with fine hairs. The head is extremely short and more rounded anteriorly than that of *Halobates*, giving the insect a somewhat oval shape (Figures 1 & 2). The eyes have a granulated appearance owing to the pronounced convexity of the individual ommatidia, whereas in *Halobates* the outer surfaces of the lenses are rather flat and form a continuous surface. The *Hermatobates* eyes further differ from those of *Halobates* in possessing long, thin inter-ommatidial hairs or setae, similar to those on other areas of the head of the insect (Figure 3). Such eye setae have been observed in some terrestrial insects by Hinton (1970), who suggested

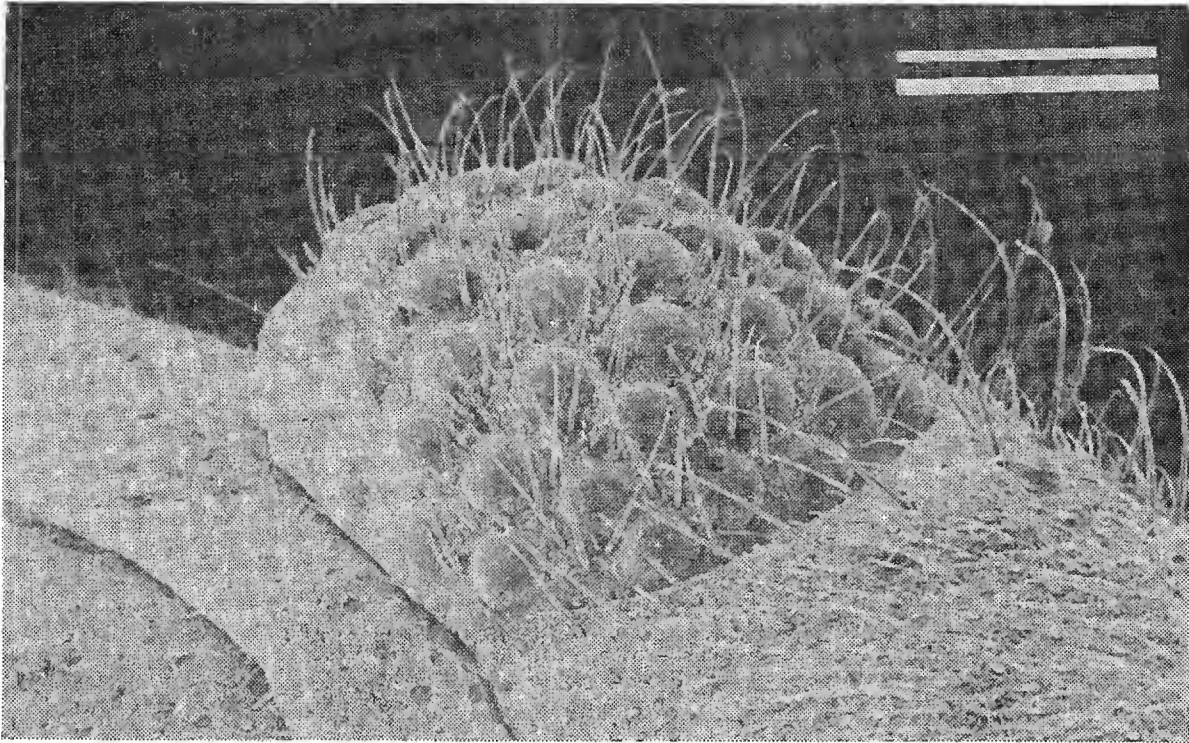


Fig. 3. Surface of eye showing inter-ommatidial hairs (stereoscan electron micrograph scale bar = 100 μ m).

that they are simply extensions of the cephalic receptor system, and do not obstruct incident light normal to the ommatidia. In some beetles such setae may help to make the eyes less conspicuous to predators (Hinton, 1970), but what function these setae may serve in the sea bug is unknown.

The pronota of these insects are very short. In the male, the meso- and meta-nota are completely fused and extend posteriorly to cover several of the fused anterior abdominal segments (Figure 1). In the female, some of the anterior abdominal segments are exposed between the lateral lobes of the mesonotum (Figure 2).

The front legs of the males of several species of *Hermatobates* are evidently modified for grasping, and bear one or more large, tooth-like tubercles in addition to smaller teeth. The tarsi of all the legs are three-segmented, although the first segment is very short. This character further distinguishes adult *Hermatobates* from other Gerridae, although during the nymphal stages the tarsi are not segmented. All distal tarsal segments bear strong claws, which are sub-apical on the front tarsus but apical on the mid and hind tarsi (Figure 4). Such claws, on both sexes, suggest that these bugs could easily cling to rocks or other objects. The middle legs are about the same length as the hind legs which are held almost at the tip of the abdomen, while in *Halobates* the middle legs are about 1.5 times as long as the hind legs, which are held halfway up the abdomen.

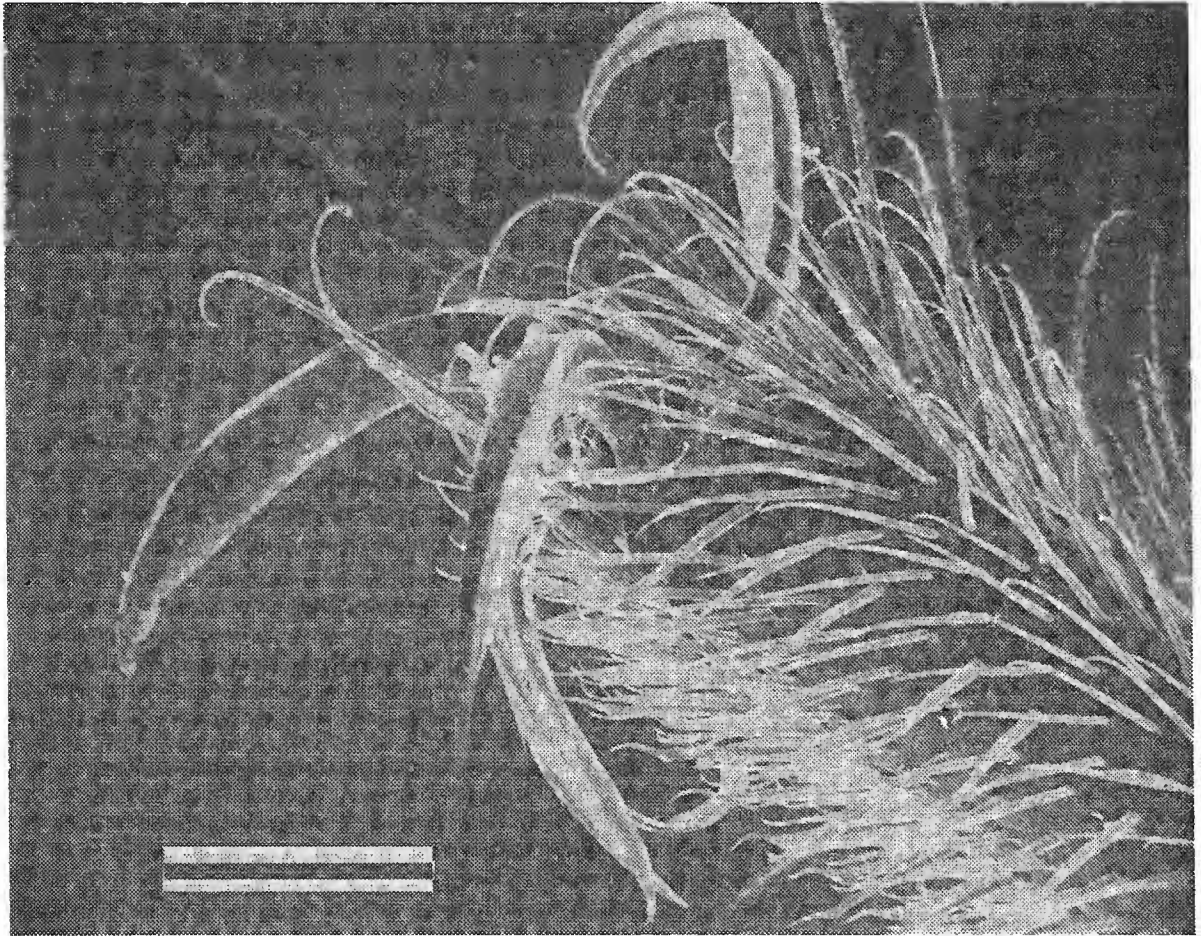
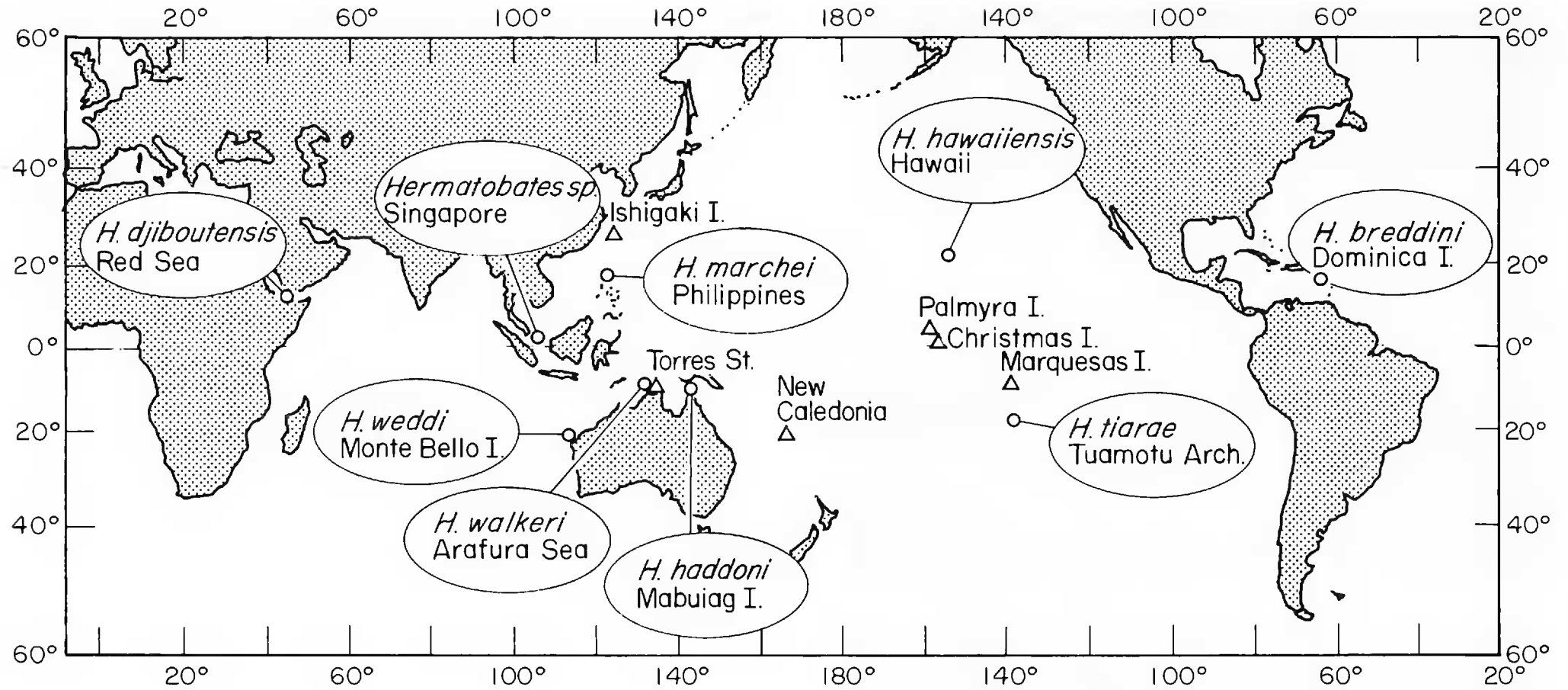


Fig. 4. Stereoscan electron micrograph of mid-tarsal claws (scale bar = 50 μm).

Biology

Our knowledge on the biology of these sea-bugs has hitherto been based on only three field observations, by Walker (1893), Esaki (1947) and Usinger & Herring (1957). Both Walker and Esaki found them together with other marine insects on coral reefs which are submerged at high tide. Walker found his specimens of *Hermatobates* under a dead *Tridacna* shell, where there was also a spider; some specimens of the ocean-strider *Halobates* were also found, in nearby salt pools left by the receding tide. Esaki found his *Hermatobates* at low tide 'walking' on the coral reefs or moving on the surface of tide pools in a manner rather different from that of other gerrids. He did not see them at high tide, and assumed that they hide in crevices or under shells. They were found together with many *Halovelgia septentrionalis* (Veliidae), an unidentified collembolan and an unidentified staphylinid beetle. He also noted that marine midges (*Clunio pacificus* and *C. setoensis*) were abundant nearby. The types of *H. weddi* and *H. walkeri* were both collected from coral reefs; those of *H.*



Map 1 Distribution of *Hermatobates* spp. showing type localities (o) and other collecting records for *H. haddoni* (Δ).

breddini and *H. tiarae* were collected at sea under lamps, as were the specimens collected off the Singapore coast.

Our first daylight glimpse of *Hermatobates* was in Noumea, New Caledonia, where these insects appeared as small silvery objects moving extremely fast over the surface of the water amongst *Sargassum* weed half exposed at low tide. Individual specimens appeared very suddenly and disappeared with equal suddenness. The first was caught after much patient waiting and fast chasing, but, once we discovered what to look for, several additional specimens were captured on two subsequent days at low tide, when the water was calm. However, no insects came to the light of lanterns hung over the water at high tide in the same locality at night.

On Heron Island we found adults as well as nymphs of *Hermatobates* at low tide during daylight hours in the afternoons, but we encountered none at our lights at night (when the winds were higher and the sea surface choppy). Adults were found skating over fast-flowing rivulets of ebbing seawater between large boulders at the ridge of the reef-flat, i.e., at the outer edge of the reef where the boulders are first exposed at receding tides. To our great surprise, we also found nymphs of various stages clinging to the undersides of such boulders, associated with *Halovelgia*, Collembola, staphylinid beetles and mites. As the water ran off the overturned rocks many of the insects began to move, while others remained motionless, enclosed in air-bubbles. It is possible that normally, as the tide recedes and the boulders became exposed, such nymphs will crawl out from their hiding places to feed, and indeed we found several of them moving over the surface of small rock pools when the tide was at its lowest level, though they became rarer and disappeared as the tide began to rise. None were seen at high tide, when presumably the insects would have crawled under boulders and survived enclosed in air bubbles until the next low tide. We could not directly observe them to do so, since such small insects (less than 2mm in size) cannot be watched in the splashing waters of an incoming tide. When living specimens were set in a laboratory aquarium supplied with dried pieces of corals and then artificially flooded, they simply rose to the surface and swam or rested with bunched up legs on the water. When bits of dead *Tubipora musica* (organ-pipe coral) were supplied as substrate, the insects readily crawled into the tubes even without flooding. On Magnetic Island, specimens of *Hermatobates* were collected in conditions more or less similar to those on Heron Island. All the collections were made at low tide during the day: here, too we were unable to do any night collecting.

From such observations we deduced that the *Hermatobates* collected previously at night lights on the open ocean were 'strays', the natural habitats of these sea-bugs being coral rubble, as indicated by Esaki (1947), and rocks in the low intertidal. At low tide they come out to feed on small animals among intertidal rocks and algae, and at

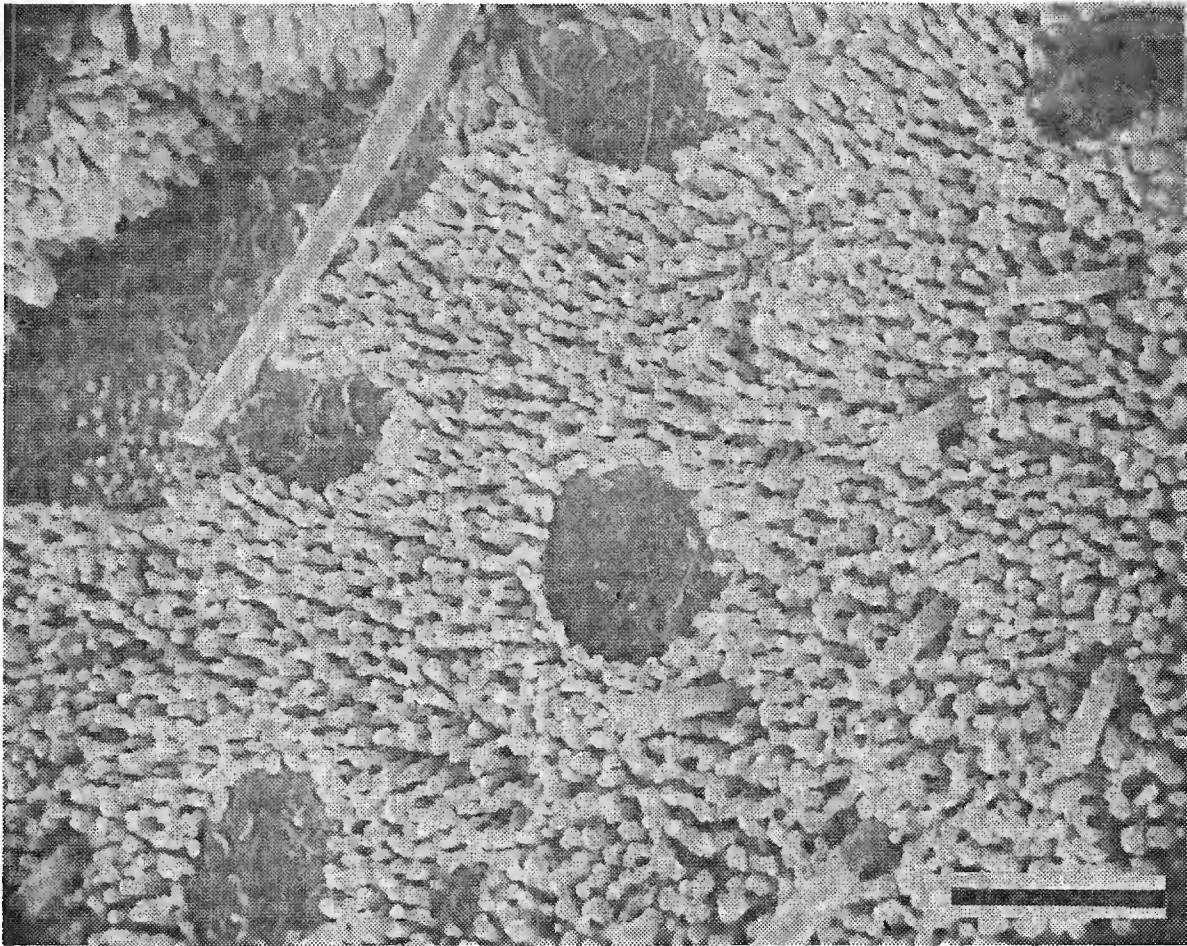


Fig. 5. Portion of thorax, showing microtrichia (stereoscan electron micrograph, scale bar = 10 μ m).

high tide they hide in crevices or under boulders, enclosing themselves in air bubbles much in the same way as do intertidal veliids and saldids (Andersen and Polhemus, 1976; Polhemus, 1976). If, however, they cannot find a resting place under water before the tide rises, they can swim or rest on the water surface for many hours. We were able to keep specimens in the laboratory on seawater for more than 5 days without their showing any ill effects. It is possible that in some areas, and at times when weather conditions are rough, the incidence of 'straying' on the sea surface can be quite high. Among surface plankton tows made in open waters off Hawaiian shores, in the course of a study of larval fish, 23 samples contained *Hermatobates hawaiiensis*: in one sample, 8 insects had been netted in less than 10 minutes (Cheng, unpublished data.).

Discussions

Hermatobates appears ideally suited to an intertidal coral reef existence. It has large eyes, presumably adapted for vision in air rather than in water (Figure 3); strong claws for clinging to algae-covered rocks (Figure 4); and a well developed plastron (Figures

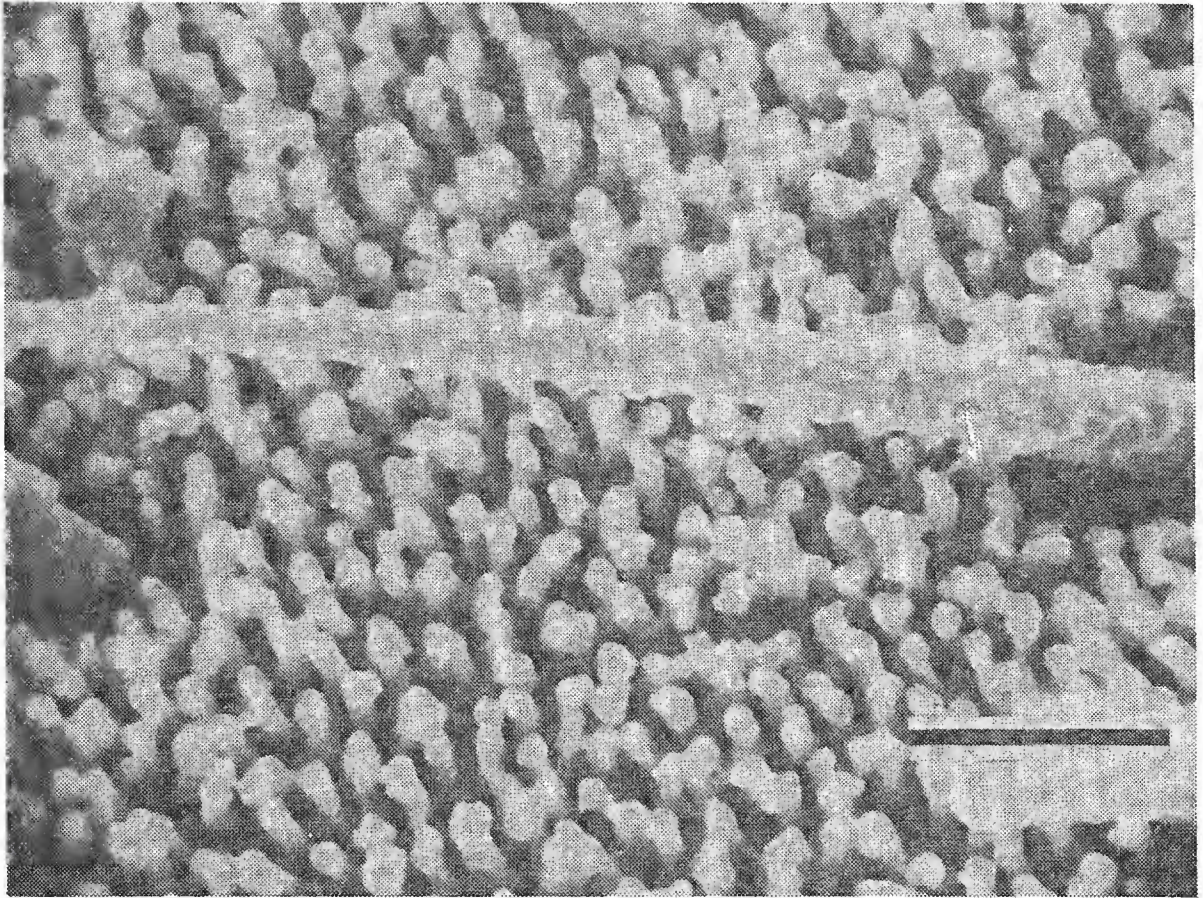


Fig. 6. Microtrichia at higher magnification (stereoscan electron micrograph, scale bar = $5\mu\text{m}$).

5 & 6) similar to that of freshwater gerrids (Cheng, 1973). The strongly developed front femora, found in males of several described species, are probably adaptations for clinging to the females. Their legs, in contrast to those of *Halobates*, are more adapted for walking over rocks than for skating over water. Although they can skim extremely quickly over water, their movements are mainly confined to short dashes as they skate from boulder to boulder; presumably they do not travel over large expanses of water as do *Halobates* (Cheng, 1974). When chased they often make for the nearest rock, cling to it and remain stationary; under such circumstances they are very hard to see, *Halobates* is unable to do so. They can also jump well; adults leaping from a water surface reach a height of 5-6 cm.

Since these insects may have to come out and feed at low tide during rain storms, experiments were carried out on the effects of reduced salinity on their activities. We detected no difference in the behavior or viability of insects kept on seawater or on freshwater over a 24-hour period.

Their ability to withstand submersion was tested by keeping insects fully immersed in boiled (deoxygenated) and unboiled seawater. In the former, they ceased to move within 10-15 minutes; if

Table 1. Type specimens of *Hermatobates* spp. with type localities.

Species	Author, Year	No., Type	Type Locality
<i>breddini</i>	Herring, 1965	1 male	Woodbridge Bay, Dominica British West Indies
<i>djiboutensis</i>	Coutière & Martin, 1901a	1 male	Djibouti, Red Sea
<i>haddoni</i>	Carpenter, 1892	1 male	Mabuiag Island, North Australia
<i>hawaiiensis</i>	China, 1956	1 male, 2 females	Coconut Island, Hawaii
<i>marchei</i>	Coutière & Martin, 1901b	1 male	Honda Bay, Philippines
<i>singaporensis</i>	Cheng, 1976	1 male, 2 females	Singapore
<i>tiarae</i>	Herring, 1965	1 male	Tuamoto Archipelago, French Oceania
<i>walkeri</i>	China, 1957	2 males	Arafura Sea, N.W. Australia
<i>weddi</i>	China, 1957	1 male	Monte Bello Islands

then released and blotted dry, they regained their mobility in 10-15 minutes. If left in boiled seawater for more than 30 minutes, however, they died. Insects submerged in ordinary seawater remained mobile for at least 6 hours; when then released and dried, they became fully active in 10-15 minutes. Nymphs appeared to withstand submersion much better than adults, remaining mobile under water for longer periods of time and, when released, regaining mobility within shorter periods of time.

Although our knowledge of the biology of these elusive sea bugs is still rather fragmentary, now that their normal habitats are known (i.e., coral rubble or reefs of tropical island shores) and the best times and methods for capturing them have been established, they may not remain so apparently rare or elusive for long.

Acknowledgments

I wish to thank the Mid-Pacific Marine Laboratory, University of Hawaii, for providing travel funds and living and research facilities at Enewetak; the Roche Institute of Marine Pharmacology, Australia, for providing accommodation and research facilities on Heron Island; the Department of Marine Science, James Cook University, for laboratory facilities; and Ralph A. Lewin for assistance in the field.

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Correction — Hippomelas Plant Associations

In a recent article on this subject (Pan-Pacific Entomologist, 52:272-285), the authors quote G.H. Nelson (*in litt.*) (p. 279) as confirming that *Hippomelas planicauda* Casey has been consistently taken on "Acacia." This should have read "Mimosa" as the data in the preceding paragraph indicate. — E.G. Linsley.